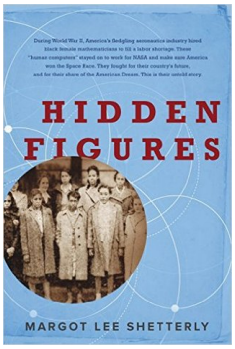
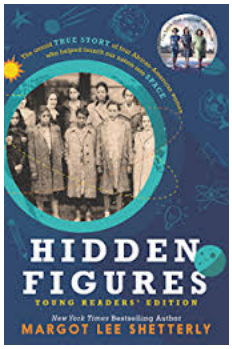
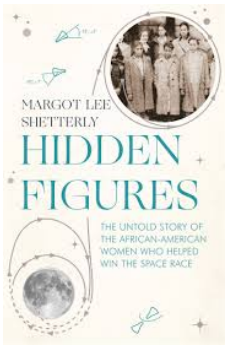
Hidden Figures, (book) *Margot Lee Shetterly*, William Morrow and Company, (2016) ISBN 978-0-062-36359-6 (hbk), 368 p.
Hidden Figures, (movie) Theodor Melfi (director), Fox 2000 Pictures, 2016, 127 min.








Margot Lee Shetterly

The book tells the story of the *Langley Research Center* of the *National Advisory Committee for Aeronautics* (NACA), founded in 1915. The center designed and tested experimental and supersonic airplanes before and during the second World War. In October 1958 it became part of the *National Aeronautics and Space Administration* (NASA) under president Eisenhower. When the USSR brought Yuri Gagarin as the first man in a single orbit in space in April 1961, president John F. Kennedy has put a lot of pressure to win the space race for the moon. Langley did tests and simulations that would eventually bring the USA alongside the USSR. They succeeded in February 1962 bringing John Glenn up there as the first American orbiting earth. Much later, in 1969 Apollo 11 brought Neil Armstrong and Buzz Aldrin to the moon.

The period covered in the book is from early 1940s till end of 1960s. The 50s and 60s coincide with the *Civil Rights* movement with people demonstrating and fighting against segregation of black Americans in courts of law. The Jim Crow laws enforced black and white children to have separate schools, there were separate seats in public transportation and restaurants, separate toilets, separate theaters, etc. It was only in 1954 that the Supreme Court in *Brown v. Board of Education* banned segregation in all public schools. Black highly qualified scientists did not get a position at a white university. So they had to take up a position in smaller black colleges. So, black students sometimes got a better education there than at the bigger universities. When during WW II many men, black as well as white, were sent out to fight, there was a group of highly qualified black women hired as (human) computers in Langley.


Dorothy Vaughan


Mary Jackson

Dorothy Vaughan quit her low paid job as a teacher to enter the computing group at Langley as did several other black female mathematicians. After a number of years, she became the de facto supervisor of this group, who worked in the segregated Western part of Langley and therefore the group became known as the *West Area Computers*. There was a white East Wing equivalent, still mainly consisting of women. The first part of the book is primarily following Dorothy in her private life and how she and several others became one of the computers at Langley. Meanwhile the history of the research center as well as the problems associated with segregation are well documented. Several of the women that entered as computers were detached to work in more specialized groups along white and male colleagues. Among them three more women are outlined with more detail in the book.

Mary Jackson who got a master in mathematics and physical sciences from Hampton Institute in 1942

was one of them. Her application to study at the University of Virginia was turned down. After several other jobs, she joined Dorothy's group in 1951 where her talents were discovered by the wind tunnel engineer Kazimierz Czarneck who asked her to work in his team. She can however not be appointed as an engineer since the rules were modified: a degree from the University of Virginia was required. So she took this to the court and was allowed to start an engineering degree at the University of Virginia which she obtained in 1958. Still much later she met, as a woman, the glass ceiling at Langley and became NASA's Federal Women's Program manager.

Also Christine Mann (after her marriage she became Christine Darden) with a mathematics degree obtained in 1962 joined the West Computers group and became a specialist in supersonic flight and sonic booms. She was the first black female that got promoted to a senior executive position at Langley.

Christine Darden

Katherine Johnson

The most mythical however was Katherine Goble (later Katherine Johnson when she remarried after her first husband died). She got adopted in the *Flight Research Division* that had to compute the re-entry trajectory of the Freedom 7 capsule that should bring John Glenn in orbit. Space travel posed new, unknown challenges to the engineers, and Katherine contributed her part in developing the new mathematics. The meeting of the board used her numbers and reports, but females were not allowed at those meetings. However, thanks to her persistence, she finally was allowed to attend. She also finished a report on the ballistic trajectory that should define the entry point in the atmosphere that would let the Mercury capsule splash down in the ocean at some predefined point. Alan Shepard was the first American in space in May 1961, but that was a rehearsal for John Glenn's orbiting flight. By that time NASA's nerve center was moved to Houston and many of Langley's employees had to move too. Katherine decided to stay in Langley. When Glenn was about to take off, the computer programs were checked and double checked, but Glenn asked "the girl" (i.e., Katherine) to verify the numbers, which she did. Relying on electronic computers was still not as accepted as it is today. Katherine's confirmation of the result made Glenn confident to indeed take off and this incident boosted Katherine's mythical fame.


The New York Times.

LATE CITY EDITION

GLENN ORBITS EARTH 3 TIMES SAFELY; PICKED UP IN CAPSULE BY DESTROYER; PRESIDENT WILL GREET HIM IN FLORIDA

When in the previous decade electronic computers had entered NACA in the 1950s, the West Computing group was reduced, many of its members were already working in permanent position in other subgroups. When in 1958 NACA became NASA, the group consisting of only 9 women was closed down and the remaining team was dispatched to different divisions. However Dorothy had taken programming courses and she was assigned to the *Analysis and Computing Division*, which was Langley's computing center equipped with big mainframe IBM computers.

The period after 1962 is wrapped up in two chapters. Several of the black West Computers got respectful positions, while they were working on the preparation of Kennedy's target to bring an American to the moon. Somehow the introduction of *Star Trek* in 1966 with an international and interracial crew was reflecting the ideal future that the Civil Rights Movement was marching for. Uhura was a black

communication specialist of the Enterprise crew. One of the first characters on screen with an African descent. Katherine was a Trekkie fan, as was Martin Luther King. The book ends with the touch down of the Eagle on the moon and Katherine already thinking of the next step to take. The more recent history and what became of the main characters is told in an epilogue. Katherine got the Presidential Medal of Freedom in 2015 from President Obama.

As mentioned before, the book is very well researched and almost half of the book consists of references to newspapers, and other publications, and many notes to give extra background information. Since the stories of the women that are followed, the historic development of the Langley research center and the history of the segregation and the Human Rights movement are mixed, yet are treated in chapters mainly devoted to one of them, the account is not always sequential and therefore a bit chaotic which is unavoidable with all the details and background provided.

Henson (Katherine) Monáe (Mary) Spencer (Dorothy)

Theodor Melfi

The film is faithful to the idea of the book, but it has much more of an entertainment factor and is less of a documentary. There are only 3 main characters: Dorothy (Octavia Spencer), Mary (Janelle Monáe), and the main star of the film is Katherine (Taraji P. Henson). The screenplay is compressing the dramatic elements. The war period of NACA is left out and the focus of the action is building up a climax towards John Glenn being launched at Cape Canaveral. In the film, Katherine at that moment had already returned to the West Computers when Glenn on his way up to the Mercury capsule asked "the girl" to check the numbers. Katherine is summoned and finishes her computations at the very last second.

There are certain discrepancies between film and book, with the latter telling the true story. For example the engineer that hired Mary is called in the movie Karl Zielinski. The head of the Space Task Group is in the movie Al Harrison (Kevin Costner) which was in reality Robert Gilruth. Harrison is the "good guy" who really appreciates Katherine's skills. Since she has to run to another building to use the colored toilets, Harrison asks her why she is so often away when he needs her. That is when she, in an outburst, lists all the discriminating rules about the bathroom, the separate coffee pot she has to use, etc. Then Harrison proclaims there is no more segregation under his supervision and tears down the colored toilet signs. In the book it is actually Mary who obtains this victory.

The "bad guy" in the movie is Paul Stafford (played by Jim Parsons) who has a hostile attitude towards Katherine while she has to work for him. He asks her to verify his computations and gives her documents that are almost completely blacked out because she does not have the security clearance. When she asks for more info, he says she didn't really have to check his numbers because it is only a formality. When she holds the pages against the light she can see the word ATLAS which is the rocket that would bring the capsule into orbit because the Redstone carrier was not strong enough but that was supposed to be 'top secret'. However using this info she can do the whole computation. This made her reputation in the group. Stafford still holds a grudge and when later she adds her name to the reports she has prepared, he repeatedly orders her to remove it.

Of course also romance gets its place in the movie as Katherine meets her second husband army officer Jim Johnson. As a dedicated feminist, she is at first giving him a hard time for his disbelief that a woman can do a job she is actually doing. But they finally get married encouraged by her teenage daughters.

In the movie Dorothy is acting leader of the West Computing group and repeatedly asks the bitchy supervisor Vivian Mitchell (Kirsten Dunst) to make this official, but it was never granted unless at the

very end when she succeeded in starting up the IBM computer something that the engineers could not. Dorothy however refuses the position unless she can take her West Computing group along. She had indeed instructed her group to become FORTRAN programmers. So Mitchell had to give in and at the head of her troop of black computers (many more than the nine of the book), she invades victoriously the computer building. In reality she was indeed officially the head of the West Computers.

The mathematics are almost not present in the book, certainly not the details and formulas. There are however equations in the movie. They look cool but may not be realistic.

Top: using the ATLAS data Katherine can compute what will bring the Mercury apsule into orbit.
Bottom left: Katherine computes the re-entry point in the atmosphere off the top of her head during the meeting which provoked Glenn to remark that 'he likes the girl's numbers'
Bottom right: Katherine uses Euler's method to solve the differential equation numerically.

Katherine is detached to Harrison's task force because he required a mathematician who knew analytic geometry. Katherine was the only qualified one and upon her arrival, Harrison asks her if she can compute the Frenet frame for certain data, and she answers affirmmative and proposes to use the Gram-Schmidt orthogonalization algorithm. This convinces Harrison that she is indeed good and assigns her to Stafford. One of the main problems Katherine solves is the transition from the elliptical orbit to the parabolic trajectory of the capsule falling back to earth. When Harrison complains this is 'new math' they do not know yet, Katherine has an aha moment and says that it is not 'new math' but 'old math' that will bring the solution, referring to Euler's method. That is the simplest numerical method to solve differential equations and an obvious thing to do now, but then in the early sixties, numerical mathematics was still in its infancy and people still tried to solve differential equations analytically.

In an interview for the *Los Angeles Times*, Katherine Johnson is asked "Do you have any advice for young women and people of color today who want to pursue a STEM career?" and her answer is "Just do it. Take all the courses in your curriculum. Do the research. Ask questions. Find someone doing what you are interested in! Be curious!".

When you are interested in the history and the life of the women behind the story, I would recommend the book. It may be a bit dry with all the details added, but you will get a broader view. For a more emotional kick, building up to a climax with a happy ending and peppered with some romance, a good and a bad guy and of course the triumphing black heroins, you should go and see the film.

Adhemar Bultheel